IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⵣ Peer-reviewed & Refereed journal ⵣ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.13370

Detection and Risk assessment of Parkinson's disease : A Machine Learning Approach

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Abstract: Leveraging DenseNet architecture, our novel approach to Parkinson's disease detection focuses on analyzing spiral and wave images derived from handwriting samples, a method proven to capture subtle motor abnormalities characteristic of the condition. By training the model on a dataset comprising annotated samples from individuals with clinically confirmed diagnoses, our system learns to discern distinctive patterns indicative of Parkinson's disease. Through the integration of traditional image processing techniques for preprocessing, we enhance the model's ability to extract relevant features from handwriting patterns. The multi-label classification enables not only the identification of Parkinson's disease presence but also offers insights into its severity and progression. This comprehensive approach empowers clinicians with a reliable tool for early diagnosis and personalized treatment planning, ultimately improving patient outcomes and quality of life.

Keywords: DenseNet architecture, Parkinson's disease detection, Spiral and wave images, Handwriting samples, Motor abnormalities, Early diagnosis

I. INTRODUCTION

The rising prevalence of Parkinson's disease has emerged as a significant public health concern, with a profound impact on individuals and healthcare systems worldwide. As the population ages, the incidence of Parkinson's disease continues to climb, underscoring the critical need for early detection and intervention strategies. Leveraging the power of machine learning, specifically DenseNet architecture, in conjunction with sophisticated analysis of spiral and wave images extracted from handwriting samples, this research endeavors to pioneer a non-invasive approach to Parkinson's disease diagnosis. By capturing subtle motor abnormalities inherent in these images, our innovative detection system offers a promising avenue for early identification of the disease, facilitating timely interventions and personalized treatment plans.The non-intrusive nature of our methodology ensures patient comfort and privacy, overcoming barriers commonly associated with traditional diagnostic techniques. Moreover, by harnessing the capabilities of deep learning algorithms, our system has the potential to enhance diagnostic accuracy and efficiency, thereby improving patient outcomes and reducing the burden on healthcare providers.In an era marked by rapid technological advancements, the integration of machine learning and medical imaging holds immense promise for revolutionizing healthcare delivery. By championing innovation in Parkinson's disease detection, this research not only addresses an urgent unmet need but also sets a precedent for leveraging technology to improve patient outcomes and promote overall well-being.

II. LITERATURE SURVEY

[1] This research proposes a novel approach for Parkinson's disease (PD) detection using DenseNet, a deep learning architecture. The method leverages spiral and wave drawings as input data. It involves analyzing these drawings using DenseNet to classify them and potentially identify features indicative of PD. While this approach has the potential to outperform traditional methods, challenges like variations in drawing styles and potential inconsistencies in the drawings themselves need to be addressed for robust detection.

[2] This paper explores a new method for Parkinson's disease (PD) detection utilizing DenseNet, a deep learning architecture. DenseNet analyzes spiral and wave drawings for potential signs of PD. Similar to advanced driver assistance systems that employ image sequences to improve accuracy, this approach leverages the sequential nature of the drawing process within a single image. By analyzing the entire drawing, DenseNet can potentially capture subtle changes that might be missed by analyzing isolated sections. This has the potential to enhance the detection of PD compared to traditional methods.

[3] The paper presents a Python-based prototype for Parkinson's disease (PD) detection using DenseNet architecture with spiral and wave images. Leveraging Python's text processing capabilities and the DLib library, alongside OpenCV's Haar Cascade Classifiers, the system efficiently analyzes subtle motor abnormalities inherent in the images. Through threading, networking, and numerical techniques, the prototype integrates DenseNet for enhanced diagnostic accuracy. This innovative approach signifies a notable advancement in early PD detection, offering potential improvements in patient outcomes and healthcare efficiency.

[4] The paper introduces an intelligent framework for Parkinson's disease (PD) detection using DenseNet architecture with spiral and wave images. It employs the Viola-Jones face detection algorithm to extract facial features from dynamically retrieved key frames. Through a stacked deep convolutional neural network (CNN), individuals are categorized based on handwriting patterns, effectively distinguishing between PD and non-PD cases. This approach outperforms conventional CNNs and includes an alert mechanism for early detection and intervention without overwhelming data acquisition processes.

III. SCOPE AND METHODOLOGY

Scope

The project aims to enhance early detection and management of Parkinson's disease (PD) through the utilization of technology. This scope encompasses research, development, and implementation of DenseNet-based analysis of spiral and wave images from handwriting samples. The technology will be designed to accurately identify subtle motor abnormalities indicative of PD. By focusing on early detection, the project seeks to improve patient outcomes and address the growing burden of PD on healthcare systems globally.

Methodology

The methodology involves utilizing a machine learning model, specifically DenseNet architecture, to analyze spiral and wave images extracted from handwriting samples for the detection of Parkinson's disease (PD). The process begins with preprocessing the images, including cropping, resizing, and normalizing pixel values. Two distinct datasets, one for spiral images and another for wave images, are independently preprocessed and trained on a Sequential DenseNet architecture. Data augmentation techniques, such as zooming and flipping, are applied to enhance the dataset's diversity. The DenseNet architecture comprises convolutional and dense layers with dropout regularization to prevent overfitting. The model is trained using the Adam optimizer and categorical cross-entropy loss function for 10 epochs, followed by validation on a separate test set to assess performance. Evaluation of the model's accuracy and effectiveness is conducted using metrics such as Accuracy, Precision, and Recall.

The ultimate objective is to integrate this model into a PD detection system that utilizes real-time analysis of handwriting samples to provide early diagnosis and intervention. The system will analyze handwritten spirals and waves in real-time, categorizing individuals as either exhibiting signs of PD or not. Upon detection of PD symptoms, the system will provide alerts to healthcare providers or patients, facilitating timely medical intervention and management. Real-time analysis is crucial for ensuring prompt detection and intervention, thereby improving patient outcomes and healthcare delivery efficiency

IV. SYSTEM ARCHITECTURE

The architectural design of the Parkinson's disease (PD) detection system primarily focuses on enhancing early diagnosis and management. Initially, the system processes data obtained from handwriting samples, particularly spiral and wave images, using DenseNet architecture. The system divides the dataset into training and testing sets, with the former used for model training and the latter for evaluation. Subsequently, the system employs convolutional layers to extract features from the images, facilitating the identification of subtle motor abnormalities associated with PD.

Unlike the facial detection system, the PD detection system does not undertake specific classification on individual regions of the handwriting samples, such as the spiral or wave patterns. Instead, it analyzes the entire image to identify patterns indicative of PD. However, further clarification is needed regarding the specific actions initiated by the system upon detection of PD symptoms. By elucidating the categorization procedure and specifying the actions taken by the alert module, the PD detection system can enhance its functionality, accuracy, and efficiency, thereby offering a more robust strategy for early PD detection and intervention.

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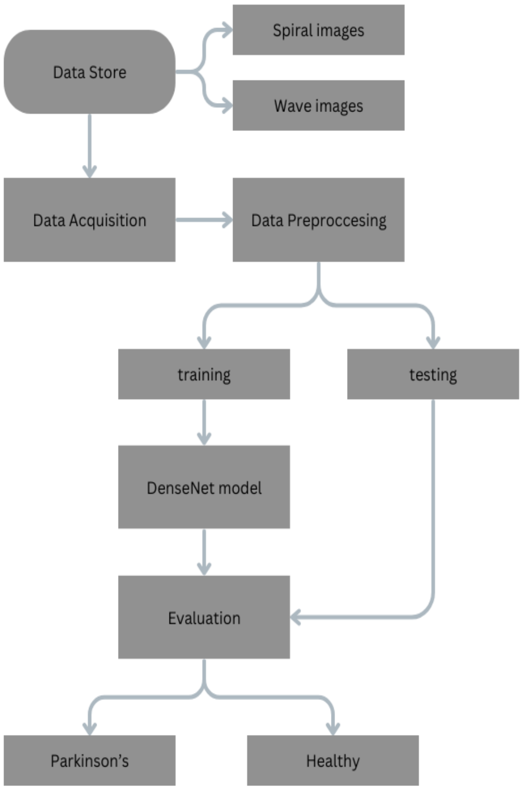

Fig.1 System architecture

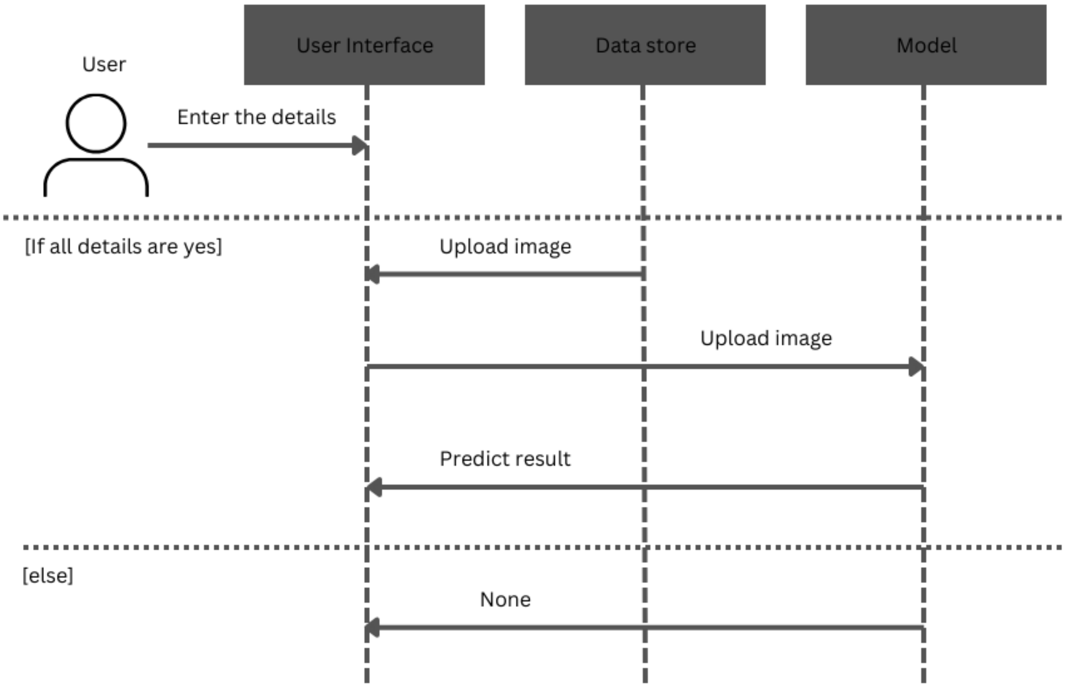

Fig. 2 Sequence Diagram

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V. CONCLUSION

The Parkinson's disease (PD) detection system demonstrates promising potential as a valuable tool for early diagnosis. Evaluated on two datasets, it exhibits high accuracy and effectiveness. Integration into comprehensive diagnostic frameworks enhances its capacity to detect PD symptoms promptly, improving patient outcomes. Together with existing methods, it holds promise in reducing undiagnosed PD cases and improving road safety. Future research should prioritize technical enhancements to improve accuracy, real-time functionality, and privacy protection, resulting in more effective strategies for early PD detection.

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